DET TELECOMMUNICATIONS VISION

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PLANNING FOR CHANGE

Drivers of Change

Computers, fiber optics, mass storage and programming are propelling us to new worlds of possibilities.

- Computers and the Integrated Circuit (IC) have created a Personal Computer (PC) revolution employing megabit memory chips which employ one micron spacing, have switching times of 10 Pico seconds (10 trillionths of a second), and present horsepower of 4 MIPS (Million Instructions Per Second) and doubling each year.

- Lightwave which includes fiber optics and laser technology, can pass 400 Megabits of information 30 miles without regeneration. Doubling every year, estimated limits are ten billion megabits or ten million gigabits. With these types of capabilities, we now have a situation where technology can easily move large amounts of information processing capabilities close to the user. Networks can be designed to interface a large number of different users to systems that provide an array of features for solving a multitude of sophisticated problems.

- Nearly 750 billion documents are in storage with 70 billion being added each year. Distributed computer systems with mass storage devices such as laser and optical disks, using the Internet, can access and search large masses of this literature.

- Programming has developed from machine language (binary numbers) programs to high level languages and eventually respond to simple voice commands.

Therefore, intelligent terminals (PCs), distributed networks, and database management programs are all complementing each other and competing to meet the needs of the new users.

Planning Process

The City must have a process in order to take advantage of the rapidly evolving technologies, that encourages a better understanding of today's needs and provides creative solutions. To meet this challenge, the need for some form of planning process has to be identified; one that is able to deal with new change and allow all levels of City management to manage change. We must have a process that:

- Encourages Innovation;
- Minimizes Risk and Cost;
- Translates Mission and Goals into Networks and Services;
- Enables Technology Planning and Technology Transfer;
- Provides a Review Process; and
- Identifies New User Needs.

Telecommunications Mission

The Department of Electricity and Telecommunications (DET) provides communications services to all City entities which includes voice and data telecommunications, radio communications, fire alarm service and other essential public safety communications services. Further, the Department is responsible for defining the strategic telecommunications direction for the City and County of San Francisco. In addition, responsibilities include selecting and evaluating communications equipment and services necessary to support the approved strategic direction. It is the mission of the Department to meet the City's communications requirements with cost-effective, reliable and responsive services and equipment.

Telecommunications Vision

The City entrusts the Department of Electricity and Telecommunications (DET) to provide the network and services necessary for the timely and cost effective transmission of information to the City's departments and constituents. This infrastructure will provide bandwidth on demand via a fiber optic backbone, interconnecting the City's major offices (PBXs), 800 MHz radio transmitters, Mayor's Emergency Telephone System (METS), E911 and Fire/Burglar Alarm monitoring, Pacific Bell Central Offices (COs), Viacom Cable Headend, and Personal Communications Services (PCS), Cellular One and GTE cellular strategic sites. DET will continue to monitor the future environment with regards to regulatory issues and phases of technology and the opportunities and problems associated with the changes. The role of the City may be expanded, by revising the City Charter, and allowing for management, procurement and distribution of equipment and services for a regional communications infrastructure for surrounding City and county governments.

Strategic Direction

The City's strategic direction must identify assumptions, risks, goals, objectives and priorities. Assumptions include: the continuing deregulation of the telecommunications industry; additional competition will continue to reduce costs for such services; and the new players in the industry will partner with other companies and government to gain access to the infrastructure and rights of ways to gain an equal footing with existing telecommunications providers. The risks include: missing the opportunity to become a key player in the region; entering into contracts which limits the City's options and potential for revenues and/or cost savings; and incurring increased costs for telecommunications services through lack of planning, commitment and leadership. Goals include: providing total information communications for City departments and constituents; automate internal operations to increase productivity and become a regional leader in governmental infrastructure implementation; promote and maintain the image of quality, integrity, and excellence in providing universal information network services; and provide City departments and constituents access to the network services. Objectives include: identify areas and boundaries, where the City can expand their operation and

scope; establish an architecture for the information network in terms of applications and restraints; define and establish a planning process to enable effective and timely utilization of City management; define and establish a technology concept and requirements for future networks and services; and establish a planning strategy in terms of new networks and services using specific business plans. Priorities include: agreeing to take a leadership role in the planning process and gaining commitment from City departments, agencies and commissions.

NETWORK AND SERVICES

Quality Information Network

In order to achieve a quality information network we must first look at the various application's work activities, such as word processing, record processing, administration support, decision support, personal computing, graphics, electronic mail, facsimile, voice mail, telephone, teleconferences (audio and video), electronic filing, database access, and image transfer. Information in the form of voice, data, text, image, still picture, full motion video, and graphics will be supported by every imaginable device. The City must maintain an open architecture implementation philosophy as proposed by the FCC with adherence to the standards of national and international committees which allows competition, internetworking and access, and standard interfaces between users and networks.

Desirable characteristics of a quality network:

- Fault Tolerance: protection from external and internal faulty interfaces requiring redundancy and alternative routing for high reliability (99.9% availability);
- Friendly User Interfaces: Graphical User Interfaces (GUI) and easy feature accessibility;
- Open Architecture: enabling modular funtionalization so that multiple vendors can interface their systems;
- Instantaneous Service: provide numerous features such as services, tests, new network configurations and reconfigurations(bandwidth on demand);
- Intelligent Network: operational database information managed with a sophisticated operational support center;
- Multiple Services: numerous features for voice, data, video, and image;
- Internetworking Numbering Plans and Billing: standards for access to public exchanges and dynamic usage billing procedures;
- Office of the Future Features: information handling enabling information to be reliably and securely moved around from network to network, processor to processor, where different work is performed;
- Creative Support Centers: provide and monitor support programs and user-feature programs in a manner that enables motivated human operated support; and
- Reliability, Maintainability, Capability, Portability, Testability, Understandability, Usability, Changeability, and Reusability.

Integrated Facilities and Features

Examples of feature integration:

Voice:

1. Local calling number display;
2. Local Citywide calling number display;
3. Duration call timers;
4. Cost of call indicators;
5. Call waiting features (calling party identifier);
6. Call transfer for selected calling numbers;
7. Voice simulation by translating calling number to personal name;
8. Voice storage within PBX and local residence environment;
9. Voice activated telephone; and
10. Personal telephone number for office, cellular, and residence.

Data:

1. Debit card;
2. Data user nets for similar applications and information exchange;
3. Specialized nets for METS, fire/burglar alarm, and 800 MHz; and
4. Information exchange services for polling, lists (databases), broadcast (video, Police, Fire, CMED), Email, and Internet access.

Image:

1. Voice/Image service terminating concurrently at user interface;
2. Image systems for medical (x-rays), police, library, etc.;
3. Specialty programs for education;
4. Text communications for store and forward; and
5. Computer networks graphics processors and language emulation/translation.

Video/Graphics:

1. Viewtext for video graphics and database access (Internet);
2. Interactive multiple user applications;
3. Video telephones (slow and full motion);
4. Video conference centers for City departments and public meetings; and
5. Transport quality grade levels (network error correction).

Needs

Requirements for a successful network are:

- Encompassing Architecture that allows the City departments and constituents to obtain universal services and promote greater productivity;

- Formation of Joint Partnerships and Franchise Agreements which will allow the City to minimize cost outlays and reduce technology provisioning and management requirements;
- Network, System and Service Packages to offer City departments and constituents access to a wide spectrum of information services;
- Formulation of Integrated Network to internetwork the City's various internal local area networks (LANs);
- Identify Data User Needs such as packet interleaving, polling, standard interface, etc.;
- Identify Data Network Parameters such as transfer time, rate structure, route selection, network interface, etc.; and
- PBX Features of which there are more than 200 available today.

LAN Internetworking

LAN users require interconnection to a wide variety of resources, including other LANs, remote host computers, public data networks, information database services, and international networks (Internet). What is really needed is a technology that offers high throughput, low delay, and efficient sharing of bandwidth (bandwidth on demand) and ports. A wide area network backbone allows multiple applications to share facilities and equipment. The backbone network combines the traffic and finds the most economic route, thus taking advantage of economies of scale, eliminating the duplication of resources, and providing the capability to reroute data over alternate paths should a link fail. A backbone network ties all of the devices together, enhancing day-to-day management of communications because status for the entire network is available in a consolidated format. Network management deals with addressing and routing considerations, congestion control, and administrative activities such as statistics and accounting data collection. Network management enhances strategic planning, allowing the City to view trends and recognize problems that are not visible at the device level. The backbone network will offer compatibility with the public network through standard interfaces which will allow for the control and performance of a private network while also taking advantage of public services.

Fast Packet, Cell Relay, ATM, BISDN and SONET

"Fast packet" is a general term for various streamlined packet technologies and refers to simplified forms of packet-mode communications, providing the benefits of reduced protocol processing (for high throughout and low delay) and statistical multiplexing (efficient use of transmission facilities by sharing bandwidth and ports). Cell relay is a term which indicates a switching technology based on fixed-length cells rather than variable-length packets (frame relay). this further simplification of the packet switching technique allows for another increased in data throughput of one or two orders of magnitude in networks based on cell relay. Asynchronous Transfer Mode (ATM) is a standard for cell relay and Broadband Integrated Service Digital Network (BISDN) is a service based on ATM standards for very high speed transmission (T3 and up). Synchronous Optical Network (SONET) is an international high-speed multiplexed

transmission standard developed to address the need for transmission speeds above DS3. It defines a basic transport level as Optical Carrier, level 1 (OC-1) at 51.840 Mbps and accommodates a DS/T3 (45 Mbps) signal. SONET defines intermediate speeds up to and including 4.976 Gbps (OC-96).

By the year 2000, frame relay traffic will be transported over BISDN trunks which themselves use SONET transmission facilities, with a large portion of voice and video traffic being handled by this technology. (see Fig. 1)

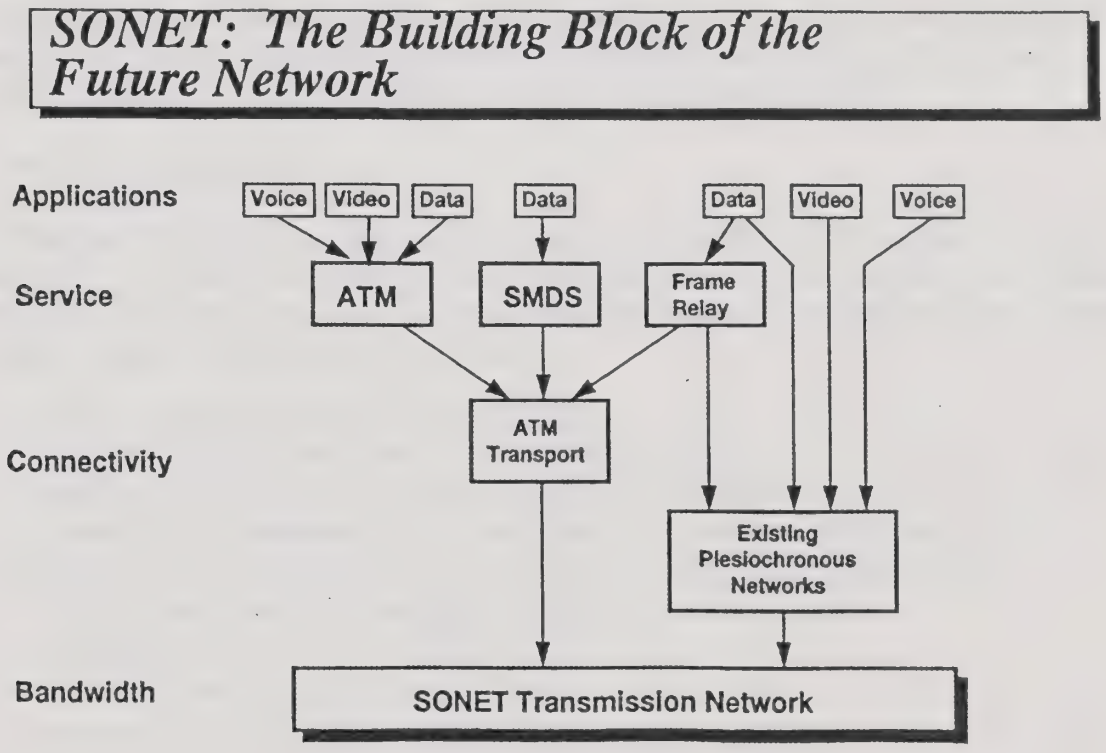

Figure 1

DOMINANT CONFIGURATION
IN THE YEAR 2000

Integrated Switching

Integrated switching combines multiple technologies in a single architecture, including network management resulting in the ability to match the best switching technology to each network application, while operating a single, unified network. Circuit switching will continue to dominate delay-sensitive applications like video and voice. Circuit switching dedicates a portion of bandwidth to each connection, not sharing the bandwidth among multiple users (which packet switching does). Frame relay will be most successful for LAN interconnect and other high throughput data applications at the core of the backbone network. Packet switching will remain important for transaction applications and for world-wide connectivity and local access. therefore an integrated switching technology,

which combines circuit, frame, and packet switching into one system, represents the optimal solution. it is not only the mix of requirements but also the need for graceful transition from one technology to another which makes integrated switching important. The cost to build and operate separate interconnected networks would be prohibitive because of the duplication of components (power supplies, card cages, disks, etc.) and the additional cost for spare parts, training for installation and maintenance, etc. The cost to operate a non-integrated network may be even more prohibitive than the high equipment costs of such a network. True integration of network management capabilities does not exist between separate networks, thus operators are faced with a diverse set of configuration requirements, user interfaces, alarm messages, statistics summaries, etc. In addition to these concerns about direct and indirect cost, there is the concern about decreased reliability and the difficulty to recover from failures quickly.

Network Management

An integrated solution for network management includes the complete responsibility checklist of operational control, administration, performance analysis, and capacity planning. The entire system is able to improve the quality of the backbone network and achieve these principle benefits: (see Fig. 2)

- Central control over multiple subnetworks;
- Integrated multipurpose network management database;
- Visibility of the static and dynamic backbone configurations;
- Automation of operational control, administration, and planning functions;
- Avoidance of parallel design and development of subnetwork components;
- Simplification of network management by a user-friendly interface;
- Easy expandability of subnetworks;
- Reduction in efforts of network performance analysis; and
- Enhanced ability for strategic planning.

Cost effectiveness of networking cannot be achieved unless efficiency in information transfer is high. Financial analysis is accomplished by means of payback, cash-flow, and return on investment analysis. The following effects would be difficult to define but would be beneficial to the City:

- Employing technology innovation;
- Improved use of instrumentation;
- Higher accuracy of deliveries;
- Increased stability;
- Improved load balancing;
- Increased credibility with the City's departments and constituents.

The following effects can be quantitatively defined for financial analysis:

1. Response time improvement;
2. Improved availability;

3. Fewer personnel for the same or higher service level;
4. Reduction in communications equipment;
5. Change in equipment;
6. Software reduction;
7. Reduction of resource demand;
8. postponement of purchases;
9. Reduction in risk of communications related decisions;
10. Better contacts with vendors;
11. Network integrity;
12. Integrated management for all communications forms (voice, data, video, image); and
13. Accounting services offered (billing).

For accomplishing the savings effects, the following cost components are evaluated:

1. Human resources;
2. Instrumentation; and
3. Computing and networking resources.

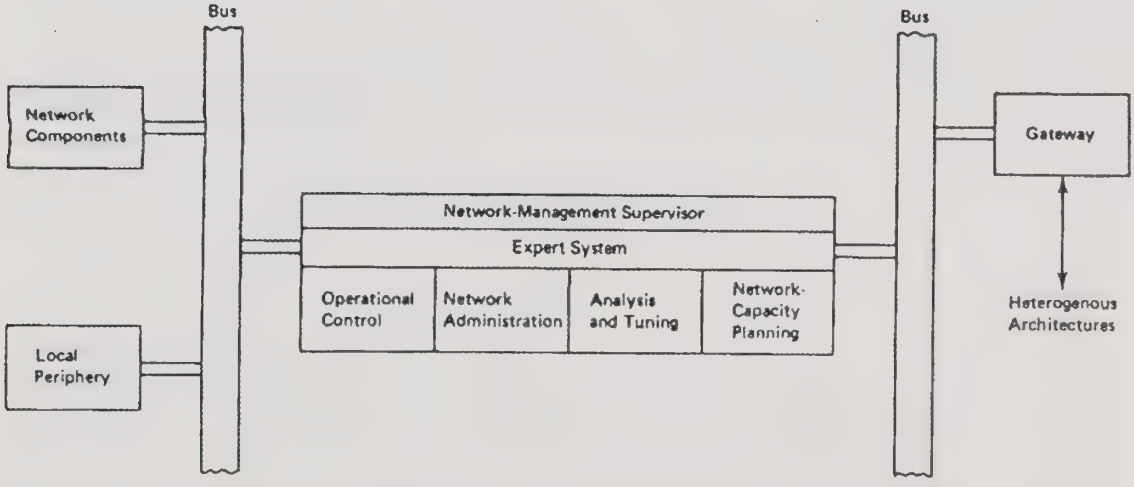

Figure 2 Target architecture

In general, the costs may be calculated by adding vectors representing tools, personnel, and computing/networking resources. The size of the vector is determined by the number of responsibilities to be considered for network operational control, network administration, performance analysis, and network capacity planning.

CITY-WIDE SUPPORT

Strategic Objectives

DET envisions a Citywide Support (CWS) function that incorporates management support, technological solutions, standard processes, and people empowerment. The CWS will allow one stop shopping, a single data repository, common tools and platforms, integrated solutions, documented methodologies, and career opportunities. The strategic objectives of the CWS:

1. Centralized, single point of contact (SPOC) for backbone network support;
2. Deliver high quality support services, consistently satisfying City department's and constituents needs.
3. Control costs and manage assets effectively;
4. Identify trends and measure performance;
5. Provide education to City departments, increasing their productivity;
6. Identify and communicate incidents of potential impact;
7. Provide technology coupled with standard processes for outstanding customer support.

DET will ensure that the CWS:

- Is accessible and available;
- Provides quality expertise;
- Responds quickly to changes;
- Increases quality and decreases costs;
- Provides support with customer service oriented people;
- Takes call ownership;
- Ensures fast response and timely resolution;
- Keeps City departments informed;
- Maintains continuous improvement; and
- Implements service level agreements and documents of understanding.

DET will implement the tools necessary to provide an effective CWS:

- Call management including call tracking, call ownership, and incident referral;
- Problem management including knowledge bases and expert systems;
- Quality management including change management, change control, and quality assurance, release management, and defect tracking;
- Communication management including Computer Telephony Integration (CTI), Automatic Call Distribution (ACD), Interactive Voice Response (VRU), Email, Voicemail, Fax, and message displays;
- Asset management including inventory, configuration, contracts, repair tracking, software distribution, charge-backs, and procurement standards;

- Systems management including systems monitors, hardware and software diagnostic devices, hardware and software detection units, remote control, system status, backups, and disaster recovery;
- Management reporting including measurements and trend analysis, publication of findings, and workflow management; and
- Specialized tools including desktop services, display units, office telephones and headsets, cellular phones, wireless communications, laptop computers, and pagers.

TELECOMMUNICATIONS

The City organizational factors:

- Budgets are in the hands of the City departments;
- Desktop devices are cheap;
- City departments need LANs;
- Planning and control are decentralized;
- Uniformity is difficult to enforce;
- Purchasing requirements; and
- Civil Service regulations.

Technical factors:

- Servers are cheaper than mainframes;
- Distributed processing is increasing;
- Users are served by LANs;
- Architectures are becoming peer-to-peer and client-server; and
- WANs are becoming networks of LANs.

Workstation trends:

- High processor speed;
- Large memory sizes;
- Megapixel displays; and
- CD-ROM.

Circuit trends:

- Over capacity in transmission facilities;
- Bandwidths are increasing; and
- Costs are decreasing.

Application Trends:

- Applications need more bandwidth (CAD/CAM, Image, Fax Servers, and the paperless office);
- Data processing is becoming more distributed; and
- Video takes less and less bandwidth.

Equipment Trends:

- Standards are improving; and
- Equipment is improving.

End User Computing Applications: (see Fig. 3)

- Email
- Order/Claims Processing
- File Transfers
- CAD/CAE
- Video/Multimedia
- Medical Imaging
- HDTV/Scientific Computing

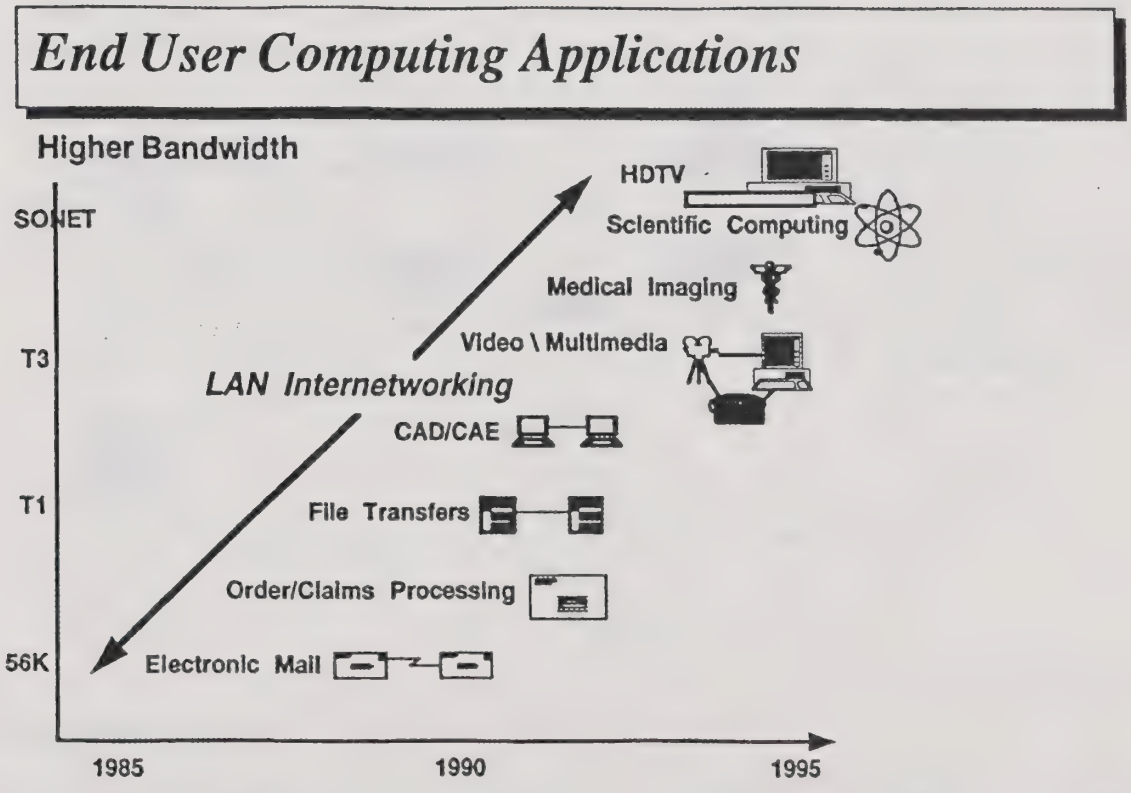

Figure 3 End User Computing Applications

SONET Market and Competitive Drivers:

- Backbone network supports voice, data, and video traffic;
- Greater transport efficiency due to aggregation of traffic;
- Higher bandwidth applications;
- Simplified architecture;
- Reduced number of network interfaces/components;
- Increased reliability;

- Dual ring internetworking;
- ATM switched;
- Self healing;
- Cost effective management; and
- Access/Network consolidation. (see Fig. 4)

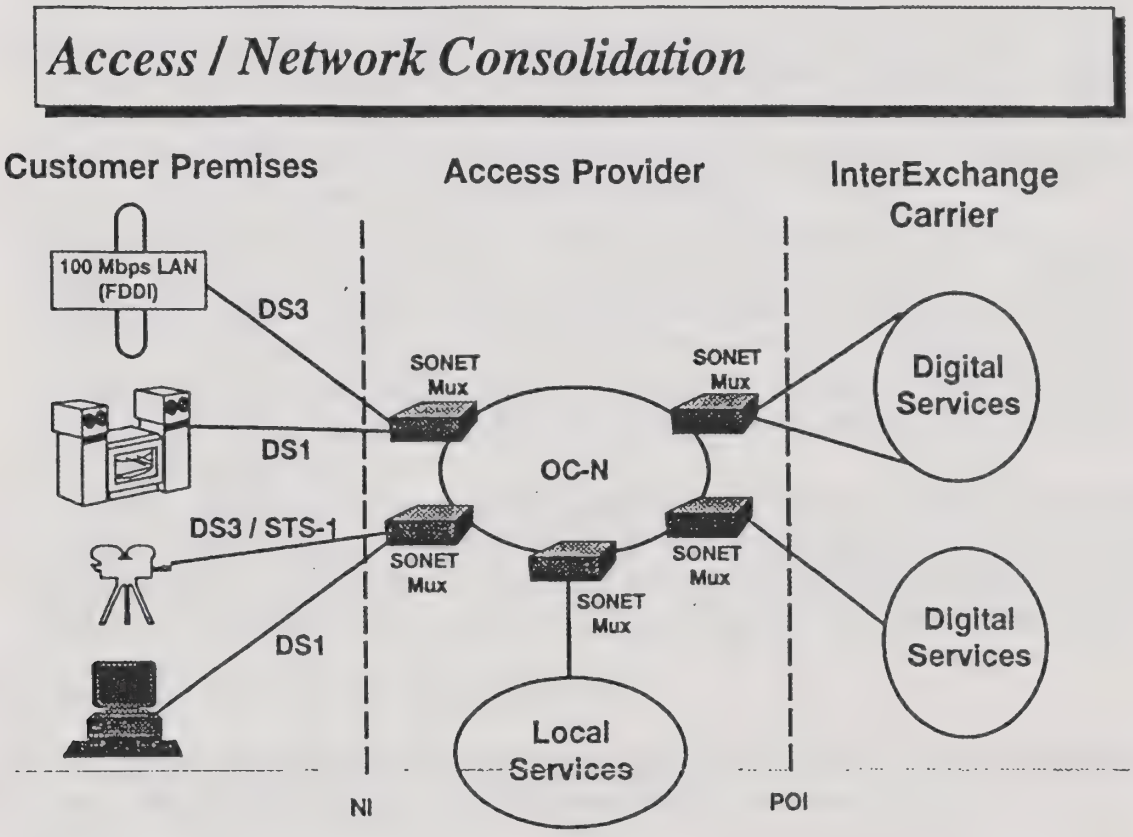

Figure 4

Regulatory Issues

Comprehensive telecommunications legislation has moved further than in any Congress since the Communications Act of 1934 was written. The Senate passed its bill (S.652) by a 81-18 margin on June 7, 1995. The House of Representatives passed H.R. 1555 by a vote of 305 to 117. The differences between the bills are now being resolved in a House/Senate conference. The bills should allow local competition, an area that lacks any level of meaningful competition. There are however, issues with the current bills:

- **Universal Service Tax** S.652 provides taxing authority to the FCC for "the preservation and advancement of universal service"; the bill requires the participation of "every telecommunications carrier" but also requires the participation of "any other

provider of telecommunications" which may include large users (the City) and causing a double taxation effect (as much as 10%).

- **Telephone Rates** Both bills prohibit the use of rate-of-return regulation by State and Federal regulators which also would prohibit consideration of earnings and productivity in determining the appropriateness of carrier rates, causing rates to be as much as $8.50 per line higher; flexible pricing would be implemented without requiring that it be contingent on the existence of local competition, which would undermine the development of local competition.
- **Competition** Both bills would remove barriers for some of the potential major competitors from merging within a market (cable television, telephone, and public utilities) thereby reducing the potential for facilities-based competition; cable television companies have been seen as the most likely companies to compete in the provision of head-to-head facilities-based local telephony.
- **Abuse Protections** The most cost-effective way of reducing the potential for Bell Operating Companies (BOC) abuses is to require that their entry into competitive businesses be separated from their monopoly activities; S.652 allows the FCC to eliminate the separate subsidiary protections and H.R. 1555 only allows for short-term use of separate subsidiary protections (5 years for electronic publishing and 18 months for long distance and manufacturing) even if a BOC still maintains its monopoly in the local telephone market.
- **Customer Contracts** Language added to S.652 would prohibit the joint marketing of interLATA and intraLATA services until the BOCs are permitted to provide long distance services; the prohibition would decrease gross usage that is used to get price discounts, thereby lowering the amount of discount and increasing the cost of service.

Cost Reductions and Revenue Increases

DET has implemented numerous budget saving ideas over the past 4 1/2 years. Following are some specific examples which have increased revenues and reduced costs.

Increased Annual revenues - $150,000 during 1994/95

- Negotiated Pacific Bell Pay Telephone Contract which increased General Fund revenues by $150,000 annually.

Reduced General Fund annual expenditures by $470,000 during 1994/95

- Negotiated Pacific Bell Business Call Discounts which reduced General Fund expenditures by $60,000 annually.
- Relocated City Hall tenants to three temporary facilities and selected Siemens Rolm as telecommunications provider through a competitive bid resulting in a $210,000 three year savings over present vendors proposed solution.
- Implemented and managed a digital T1 electronic tandem network (ETN) for voice and some data (approximately 200 T1 trunks) at a $20,000 annual savings to the General Fund over a point-to-point network.

- DET assumed the telecommunications wiring of public buildings from DPW and has lowered the effective costs by approximately $180,000 annually to the General Fund.

Previous General Fund revenue increases and cost reductions have included:

- DET eliminated a complete layer of middle management. This has allowed DET to effectively compete for and win the PUC-Bureau of Light, Heat and Power Street Light Maintenance contract. When the 3-year contract was bid in 1993, BLHP estimated an annual cost of $880,000. DET's bid was $569,000 per year resulting in annual savings of $311,000 to the BLHP general fund requirements. Initial DET start-up costs reduced the net savings to approximately $800,000 to the General Fund over the 3-year life of the contract.
- DET utilized existing resources at the Central Fire Alarm to monitor over 70 new intrusion and fire alarms in City buildings (either new or replacement of private vendors) at a savings of about $60 per month or $25,000 annually to the General Fund.
- DET increased coin telephone long distances revenues to the General Fund from $6,000 to $30,000 per month by negotiating and utilizing a nationally competitively bid contract.
- DET has constantly upgraded and maximized the City's telecommunications networks to offset cost increases imposed by Pacific Bell or AT&T.
- DET has increased the telecommunications personnel productivity of five (5) analysts to proactively handle 180 sites and 18,000 telephone stations (3,600 stations each, industry average for analysts is 2,500 stations). Additionally, analysts are required to function as project managers for telecommunications cutovers such as the City Hall move to 401 Van Ness, 875 Stevenson Street and 633 Folsom Street.

Budget saving plans included as part of this year's budget

- DET moved complete telecommunications group to work order. We are very competitive in all services provided by Department.
- Public Defender Videoconferencing installed which is reducing 500 trips yearly between the HOJ, Public Defender and the San Bruno Jail.
- New Work Order Accounting System in 1995-6 which improves chargeback to departments and provides management information for department managers allowing DET to better manage and control costs.

Efficiency plans in the future

- Competitively bid Telecommunications long distance, service area and local usage estimated at $7 million annually with a projected savings of $1 million per year to the General Fund.
- Competitively bid Telecommunications equipment and services estimated at $1.9 million annually with a projected annual savings of $200,000 over present contract to the General Fund.

- Competitively bid Telecommunications Secondary Market equipment estimated at $500,000 annually with a projected annual savings of $50,000 over present contract to the General Fund.
- Competitively bid the estimated $600,000 telecommunications equipment maintenance as the existing purchase maintenance agreements terminate with estimated projected savings of $30,000 to the General Fund.
- Decrease City-wide Pacific Bell data lines by converting to less expensive Advanced Digital Network lines to eliminate 35% tariff increase.
- Increase Centralized Telecommunications Bill Processing staff and automation. Automation and staff resources can be used to determine how accounts can be further consolidated to achieve cost savings of $10,000-$30,000 annually to the General Fund.
- Increase DET staff and contract with private firm for auditing to determine refunds for City which will be used to increase billing automation services.
- Competitively bid pager services which may result in 10% savings with estimated annual savings of $25,000 to the General Fund. May be initial disruption in service because phone numbers may need to be changed.
- Competitively bid cellular services which may result in 10% savings with estimated annual savings of $75,000 to the General Fund. May be initial disruption in service because phone numbers may need to be changed.

Ideas for Efficiencies

- DET is consolidating many of the services performed between the 800 MHz project and the 911 project which will result in savings to the general fund.

Until recently, the City has never had to deal with the competitive world of unregulated telecommunications providers. DET is hindered from taking advantage of many services in an expedited fashion because of the slow process involved in competitive bid services, i.e., interLATA services, intraLATA services, etc. We should be allowed to pick multiple vendors for a single contract which in turn will provide the City with the lowest price, i.e., down to the hour for long distance. Therefore, in the opinion of DET, contracts have to be significantly changed to allow competitive bidding for new telecommunications services.

Additionally, DET would like to bid for various telecommunications services which are performed by private businesses and offered to the public, i.e., alarm monitoring and fire monitoring. Administrative Code needs to be updated which allows City agencies to compete head-to-head and on a equal footing with the private industry for competitive services.

RADIO

Introduction

Since Marconi invented the spark gap transmitter, the technological march to wireless communications, more commonly known as "radio" has sometimes turned into a speedway race. It is certainly the case today. The advent of dense semi-conductor devices has bolstered the development of wireless communications that several years ago were nothing more than objects in cartoons and science fiction stories. Today, advanced techniques of radio system design plays a significant role in wireless communications, but it is becoming more a part of a bigger picture rather than the only picture.

As wireless technology enters the 21st century, City workers may become more empowered with the ability to communicate through mobile electronic devices. The greatest effect of wireless communications to City workers will probably be in the realm of non-public safety services. The increasing demand for City services and smaller government may be partly answered by use of wireless technology. Information is time-valued. The speedy processing of correct information, on demand, and at the job site may result in a more efficient, reliable, and better public service. Public safety services on the other hand will always need a private radio system. Police, Fire, EMS, requires instantaneous, exclusive use, non-interference, emergency, and prioritized radio communications. These criteria and special requirements of public safety communications are not available from commercial radio system operators.

San Francisco has embarked on such a project. It is known as the Citywide 800 MHz Radio System. It is expected to meet the City's public safety radio communication needs of public safety to year 2000 and beyond. It includes voice and mobile data transmissions for all departmental users. Although this project is underway, the City's public safety agencies may still take advantage of commercial wireless services. For example, the San Francisco Police Department, as part of the C.O.P.S./ M.O.R.E. program, is planning to procure mobile computing terminals prior to the full implementation of the Citywide radio project. This early move maybe risky in terms of equipment compatibility. What the Police may buy may not work on what the Citywide radio project implements. Considering the Police department's goals, the risk may be worth taking. It is the intent of the mobile computing terminals to minimize the time that an officer takes to complete incident reports. The plan is to provide officers with an on-site filing mechanism which may result in having valuable officer time spent more on the street, rather than at the station filling out reports. Subscription to a commercial wireless service such as the Cellular Digital Packet Data (CDPD), may very well bridge the gap before the completion of the Citywide radio project.

Vision

Wireless communications will bring to municipal government uses and needs yet to be identified. The lessons learned from Xerox's invention of the photocopier will be replicated by wireless communications and allow users to redefine the work environment. Further advances in wireless or radio communication design techniques, coupled with advances in wired communications will provide a communication system that is layered and overlaid. Mobile communications will be overlaid and interconnected on different layers of radio bands, infra-red, low orbiting satellites, spread spectrum, coaxial cables, optical fibers, microwaves, and twisted copper to provide and form a seamless and transparent communication infrastructure. Even private radio systems, such as the Citywide 800 MHz Radio System has the potential to utilize technologies that will provide public safety personnel with access to information with ease that is now difficult to achieve.
As wireless communications presents and opens solutions, it also creates problems. In some instances, wireless technology may reveal a problem that is considered as the norm today. For example, before pagers became cheap and cost effective, it was the accepted norm to receive notification through paper messages. However, the City must be cognizant of the problems that wireless technology will bring along with the benefits and solutions it offers.

Some of the benefits of wireless communication to the City are:

1. A very effective mobile workforce: Commercial wireless services and the City's private radio network will enhance the effectiveness of the City's mobile workforce by providing them immediate access to information as needed. Time delays caused by researching records, documents, and ordinances in the office may be alleviated through wireless access by workers out in the field.

2. Economies through consolidation of wireless devices: It is only a matter of time that pagers and cellular telephones will be consolidated into a single wireless device which will perform these basic functions. Furthermore, future wireless devices will incorporate mobile data capabilities at competitive rates that it may become cost effective to equip the City's field workers.

3. Birth of the single and personal number: Wireless technology will also move from discrete numbers for specific service, i.e., pager number, cellular number, office number, mobile data terminal number, etc., into a single personal number assigned to a City worker. This will result in a simplified directory, follow the worker, and potentially reduce the cost of voice mail services.

4. Potential revenue through Personal Communications Services (PCS) site leases on City facilities: PCS will require a significant number of microcell sites to provide the services it touts. The City is in a position to generate revenue by leasing cell sites on City properties such as light poles, buildings, parks, and other structures.

In spite of some apparent benefits of wireless communication, the problems they create are just as important. For example:

1. The birth of a personal number that follow people movement will create a problem to current 911 services. Unless the wireless devices are equipped with a geo-location system, an emergency call originating from a wireless device will compound the City's ability to locate, dispatch, and respond to the emergency.

2. The proliferation of wireless devices, which are basically radios, may create electromagnetic incompatibility with other consumer electronic products. There has been reports that earlier implementation of Ericcson's Global System for Mobile communications in Europe affected hearing aids, pacemakers, and other medical devices when they transmit.

3. The implementation of wireless communication will involve hundreds of cell sites with transmitting and receiving antennas. Currently, antenna design does not take aesthetics into consideration. Depending on location, a cell site may be ideal for radio transmissions but may be unsightly or incongruent with the surroundings.

The City must play a strong role in both the private and public sector of wireless telecommunications. The FCC which regulates this industry has been lackluster in imposing strict standards. The argument for loose or non-existent standards is that they impede technical development. However, technical development and the City's participation or procurement of new wireless technology must be based on reasonable social conscience. As the City faces the current and future state of wireless technologies, action on some issues that are addressed today may prove to be beneficial tomorrow. For example:

1. Adopting maintenance program and responsibility: Public safety private radio systems requires a City maintenance program to ensure that uninterrupted communications are maintained. As in the past, DET will provide a reliable and cost effective maintenance program for the new Citywide 800 MHz radio system. The comprehensive network management system, defined by DET in the project will allow current staffing levels to provide the necessary service levels. The maintenance of subscriber equipment in the commercially run wireless services will be relegated to inventory and accounting.

2. Adopting open architecture technical standards: The City must insist on open architecture standards for private radio systems. It is the only way to ensure true competitive procurement through multiple sourcing for any future replacements, expansions, additions, and upgrades. Insisting on a standard will protect any City investments on radio equipment.

3. Studying the feasibility for a local ordinance on electromagnetic compatibility: This issue is very complex and controversial. However, that should not deter the City from conducting an investigation or study as to the health hazards of wireless communication devices. The fact that wireless communication devices have been typed-accepted by the FCC do not necessarily mean that they will be harmless to users or other users of electronic devices.

Citywide 800 MHz Radio System Project

The Citywide 800 MHz Radio System Project is an example of a private radio system. Although it will supplant existing private radio systems, it is a first in the City's history on two grounds. First, the project has broken down the historically independent departmental views in radio system design, requirements, funding, and procurement. Second, it will provide the City with a common radio communication infrastructure that is flexible and capable of meeting many unique and special requirements of a multitude of end users, especially public safety.

To the extent that the Citywide 800 MHz Radio System is constrained by the limitations of spectrum, cost, and technology, the choice in design will focus on a technique called "trunking." The dynamic allocation of talk channels inherent in trunking, will provide the efficiency required to support a wide number of City users with less channels. However, the initial cost of implementing this technology is expensive, especially to a single department. Affordability and economies of scale are realized when City departments came to an agreement on a common radio communication goal and agreed to pool their moneys.

The Citywide 800 MHz Radio System Project will also attempt to address public safety radio communications in a changed City environment. In the past as it is today, the City's "master plan" do not consider the radio communication requirements of public safety providers when approving construction of buildings. Growth has resulted in new construction of high-rises and underground facilities in San Francisco within the last twenty years while the existing public safety and local government radio communication systems remained a patchwork of fixes. Radio signals are affected by the surroundings, and high-rises block or change signal directions. When this happens, the effectiveness of existing Police, Fire and EMS radio systems are drastically reduced. The irony is that the City is obligated to deliver Police, Fire and EMS services to occupants of high-rises and underground facilities regardless of residency.

The Citywide 800 MHz Radio System Project will attempt to resolve these problems by implementing a simulcast system. A simulcast system is simply the installation of two or more radio transmitter sites that is coherently operated. Coupled with trunking techniques, a simulcast trunked radio system will provide a private radio system for the City that will mitigate the effects and demands of the City's current structural environment.

State of the art private radio systems, such as the Citywide 800 MHz Radio System Project is a niche market when compared to the overall commercial and consumer radio markets. Manufacturers generally enter this market with a strategy of corralling aftermarket sales. This has lead to proprietary systems which locks the buyer to the manufacturer for upgrades, expansion, and maintenance parts. Sales of proprietary private radio systems has been fueled by competition, differing government procurement procedures, lack of standards, and an unorganized user base.

The Citywide 800 MHz Radio System will bring a radio system to the City that will provide:

- a reliable, private, and exclusive use radio communication system;
- a common radio infrastructure supporting multiple departments;
- seamless interoperability among departments;
- seamless interoperability with other government agencies;
- secure communications for sensitive transmissions;
- support for mobile computing;
- departments with freedom to re-configure service areas without being hampered by communications;
- a cost effective City operated maintenance program; and
- multiple sources for equipment.

Personal Communications Services (PCS)

The FCC recently auctioned a portion of the 2GHz spectrum for emerging technology applications and awarded licenses to the highest bidder. The auction was concluded on March 13, 1995. The winning bidders for the San Francisco-Oakland-San Jose trading area are WirelessCo., L.P. and Pactel Mobile Services. WirelessCo., L.P., is a limited partnership comprised of Sprint, Comcast, Cox Communications, and TeleCommunications. Pactel Mobile Services, is a division of Pacific Telesis. These companies intend to implement a wireless Personal Communication Service nationwide.

The PCS industry's vision is to provide a wireless communication device that may keep a citizen in touch with another anywhere they go. It is the intent of the PCS industry to enter the market by first offering cellular-like telephone services. However, the industry's approach will not duplicate the cellular telephone's entry into the market where a large cash outlay is required to subscribe to the services. Rather, it will try to duplicate telephone services of long ago. In those historical times, a person who needs telephone service was connected and provided a telephone set at no charge by the telephone company. PCS will duplicate this approach by giving wireless instruments free and charging monthly fees at the same or lower than house telephone charges. As the PCS industry matures, other enhancements and features to the system will grow and include the capability to send and receive fax, e-mail, personal numbers, paging, access to other networks and databases.

The advent of PCS affects the City in that part of the spectrum that the FCC auctioned off is licensed to the City. The City is licensed on two microwave radio systems operated by the Police and Fire departments for public safety dispatching. The PCS license winners are obligated to clear the spectrum before they can implement their system. Clearing the spectrum requires that incumbents, such as the City, be provided with a free replacement and 'comparable' systems.

This may appear as an opportunity for the City to upgrade and obtain a portion of some very critical public safety communication systems at no cost. However, the Police and Fire Department's microwave radio systems are being addressed in the Citywide 800 MHz Radio System Project. PCS's fast track and demand for early relocation of incumbents, i.e., clearing the spectrum, presents not only legal but also logistical problems for the Citywide radio project. Issues such as type of equipment, voice/data/video capacity, topology, and bandwidth requirements are yet to be determined by the project. It is therefore the initial intent of the City to leave existing microwave equipment in place until the Citywide radio project is complete. Still, Columbia Spectrum Management, representing WirelessCo, and Pactel Mobile Services has approached the City about the feasibility of a relocation program. Considering the requirements of other related projects with the least impact on the Citywide radio system design criteria, the City will consider relocation if requirements of the 911 CAD/RMS projects could be met. As of this writing, negotiations between the City, Columbia Spectrum Management, and Pactel Mobile Services are in progress. Timely implementation of the PCS system depends on the success of this negotiation.

The PCS industry will bring a personal wireless communication system to the City that will provide:

- a single and personal number identity;
- a consolidated wireless device for cellular-like telephone, fax, e-mail, and other data;
- affordable subscription rates;
- revenue for site leases on City facilities;
- effective mobility for city workers;
- a simplified number directory; and
- administrative communication for city workers, or secondary communication for public safety.

Cellular Telephone and Paging

Cellular telephone services as it is currently known as today may disappear as a result of the PCS entry into the market. At a minimum, cellular service providers will probably change it's marketing strategy and lower service charges along the line of PCS providers. Cellular telephone service providers must also offer the same capabilities as the PCS industry or follow the road to extinction. The technology, infrastructure, and spectrum

used in current cellular telephone systems are certainly there to compete or join the PCS industry.

Another form of wireless personal notification is paging. Paging today services a very specific purpose of one-way notification. This specific service, by itself, may also disappear as PCS becomes a reality. Paging in the PCS world may be just a feature probably at no additional cost to the consumer. Even in today's cellular telephone services, paging is already an option that could be activated in cellular telephone devices. Like the cellular industry, current paging infrastructure occupies radio spectrum which may be utilized for another form of data transmission. Alpha-numeric paging service providers, like Skytel already have these capabilities.

The advent and entry of the PCS industry will cause the cellular and paging services in the City to provide:

- competitive rates;
- other features such as high speed data; and
- potential terrestrial interconnect system with mobile satellite communications.

Summary

Advances in wireless communications is occurring in many areas and being deployed as rapidly as consumers purchase wireless products. Wireless communication systems will receive very high visibility as it offers new devices to the consumer. Some of the telecommunications technologies issues are standards, environmental impact, costs, and effects in the workplace. Although these issues are complex, they are not insurmountable.

PUBLIC SAFETY

Infrastructure

The Public Safety Network encompasses the entire City and consists of 220 miles of overhead wire and cable, and 90 miles of underground cable supporting the following systems:

Fire alarm box circuits;
Mayor's Emergency Telephone System (METS);
SFFD Computer Aided Dispatch System (CAD);
Auxiliary Water Supply System (AWSS) control circuits;
Local government radio circuits; and
Digital burglar and fire alarm circuits.

The majority of the underground portion of the Public Safety Network is installed in Pacific Bell substructures free of charge. The agreement for this arrangement expires in the year 2011, when a new agreement must be reached, or the City must reroute the

cables. DET presently has access to Viacom conduits, which also extend to all areas of the City, for the purpose of emergency communications. There is no time limit on this agreement. On all new overhead to underground conversion projects DET installs facilities in Viacom conduit. As much DET cable as possible should be rerouted to Viacom conduit before the Pacific Bell agreement expires.

Other City agencies, such as DPW and Muni, own conduit in various areas of the City. Development of a composite drawing of these facilities, along with DET owned conduit and conduit owned by Viacom which DET has access to, would enable DET to design a city owned and maintained network of fiber and/or cable connecting telephone switches at various locations. Presently these switches are connected by leased T-1 lines at a substantial cost to the City.

Technology and New Business

T-1 technology is now being used on the Public Safety Network primarily to deliver more Mayor's Emergency Telephone System (METS) extensions and Auxiliary Water Supply System (AWSS) control circuits to the Twin Peaks area. It is also being tested for distance capability in order to deliver more circuits to the southeast area of the City. DET will be able to increase the capacity of the network by using this technology with the existing infrastructure. This will be done at a fraction of the cost of installing larger cables and will allow the city to connect the Central Fire Alarm Station (CFAS) to new facilities at Hunter's Point Shipyard, and other remote sites, using city owned facilities and avoiding the cost of leasing lines.

It is now in the plans for the new 911 Combined Dispatch Center to establish a T-1 connection from CFAS to each of the forty-seven fire stations on DET lines. This added capacity can be used for digital communication to all areas of the City. By using the firehouses as hubs, additional circuits can easily be added to the METS, AWSS, and SFFD CAD system with a minimum of new cable installation.

This technology will also allow DET to make circuits available for direct digital fire alarm reporting to CFAS from city owned or commercial fire alarm systems as a back up to Pacific Bell circuits. Presently, two outgoing lines are required for UL approved fire alarm systems to report to privately owned monitoring companies (central stations). There are approximately 8,000 alarms in the City now received by private alarm monitoring companies (most of which are out of the City and many out of state), and then re-transmitted to CFAS over the commercial telephone line. By using city owned and maintained circuits as the second outgoing line, and reporting directly to CFAS, alarms will be more reliable and response times will improve while the City recovers the full cost of providing the service through monitoring fees.

The Public Safety Division has installed a digital receiver to monitor City-owned burglar and fire alarms. There are currently seventy alarms connected directly to CFAS via digital

communicators. DET has consulted with SFFD and is attempting to obtain a policy decision by the fire commission to pursue legislation requiring fire alarm systems to report directly to CFAS, bypassing central stations.

Street Lighting

DET now maintains one half of the City's street lighting facilities under the direction of PUC Bureau of Light, Heat, and Power (BLHP). DET is now working with BLHP to convert from a contract to an interdepartmental work order. It is anticipated that DET will perform any future street lighting work that is assumed by BLHP. There will be additions to the system when military areas are converted to municipal areas. There is also a possibility that BLHP may acquire PG&E street lighting facilities.

MISSION STATEMENT

The Department of Electricity and Telecommunications (DET) mission is to provide the City and County of San Francisco (CCSF) with cost-effective, reliable and responsive public safety communications services and equipment. The Department is responsible for defining the strategic telecommunications direction for the CCSF which includes selecting and evaluating communications equipment and services necessary to support the approved direction. DET, also, provisions communications services to all City entities which includes voice and data telecommunications, project management for the new 800MHz radio system and related 911 telecommunications components, radio communications, fire alarm service and other essential public safety communications services. Additionally, the Department is responsible for street light maintenance for City-owned street lights and monitoring of City agency intrusion alarms.

SUMMARY OF KEY ISSUES AND MAJOR PROJECTS

The Department of Electricity and Telecommunications (DET) is faced with the following critical decision which must be made within the next two months:

Major Decision Point

The 800MHz project is moving quicker than the establishment of the new 911 center. A decision must be made on whether to spend up to $5 million for a possible six-month interim solution to bring the 800MHz project on-line prior to opening the 911 center or slowing down the 800MHz project to coincide with the opening of the 911 center.

Key Projects

- Major development of the competitive bid specifications and implementation of the $40 million 800MHz project.
- The preparation of $30 million of competitive bid specifications and the implementation of various telecommunications components for the new 911 center. Bid specifications include the new 911 answering equipment, re-engineering the Pacific Bell 911 call delivery system, ergonomically designed dispatch consoles, state-of-the-art wiring of the 911 center, installation of a new 911 telecommunications telephone system, and other required functions in relation to the 911 system.
- Develop and award competitive bid specifications for:
    - PBX and Key System Master Agreement with an estimated value of $9.5 million
    - Telecommunications materials and supplies
    - Secondary equipment market
    - Telecommunications maintainance contract
    - Local and long distance usage contracts
    - Telecommunications expenditure audit
    - Paging and cellular services
- Project management for 3 Com Park.
- Implementation and installation of $3 million worth of mobile communications terminals in police radio vehicles.
- Performing radio consulting services for the San Francisco Water Department for a new radio system.
- Design and engineering of Hetch Hetchy Supervisor's Control and Data Acquisition System (SCADA).
- Design and engineering of the Water Department Supervisor's Control and Data Acquisition System (SCADA).

- Development of competitive bid specifications for the 911 dispatch consoles.
- Providing technical assistance to the Board of Supervisors for the proposed implementation of personal communications systems (PCS) by various vendors in CCSF.
- Preparing plans and implementation for the total rewiring of City Hall prior to reoccupation.
- Project management for the telecommunications system for the City Hall reoccupation.
- Project management for the telecommunications system for the Court House.
- Project management for the telecommunications system for the new Main Library.
- Project management for all telecommunications systems for all City departments which includes new fire stations and police stations.
- Telecommunications billing and call management reports.

DEPARTMENT OF ELECTRICITY & TELECOMMUNICATIONS
DESCRIPTION OF THE DEPARTMENT

The Department of Electricity and Telecommunications (DET) provides the City and County of San Francisco (CCSF) with cost-effective, reliable and responsive communications services and equipment. The Department defines the strategic telecommunications direction for the CCSF. This includes selecting and evaluating communications equipment and services necessary to support the approved strategic direction. DET, also, provisions communications services to all City entities which includes voice and data telecommunications, project management for the new 800MHz radio system and related 911 telecommunications components, radio communications, fire alarm service and other essential public safety communications services. Additionally, the Department is responsible for street light maintenance throughout the CCSF. The Department has five divisions: Telecommunications, 800MHz Project Management, Radio, Administration and Public Safety, which are listed below:

I. TELECOMMUNICATIONS DIVISION

The Telecommunications Division is comprised of Facilities Division, Telecommunications Analysts, and Network Engineering. The Telecommunications Division is 100% workorder monies from other City departments.

Facilities Division

The Facilities Division performs telephone and data wiring for most City agencies. Responsibilities include in-house wiring, voice terminal installation, PBX switch translations and local and wide area network installations. The majority of these tasks are carried out during normal day-to-day operations. The Division's project management responsibilities include providing fixed contract estimates and on-site consulting services. The Division is also responsible for the repair and maintenance of the Mayor's Emergency Telephone System (METS).

Telecommunications Analysts

Telecommunications analysts manage specific City locations and act as a single point of contact. City locations are distributed according to size, hardware installed and department. Multi-tenant locations (locations with multiple City departments) are managed by one analyst in conjunction with the other analysts responsible for a particular department. All locations have a part-time system administrator on-site staffed by the user department. The system administrator acts as the single point of contact for each location. Trouble tickets and work orders are processed through the system administrator to the analyst for trouble resolution and/or order accuracy, applicability, verification and scheduling. DET has user department contacts and department users authorized to order and fund products and services.

Network Engineering

Network engineering assists the analysts and system administrators in network and equipment design, trouble resolution and procurement of City-wide products and services.

Additionally, the Telecommunications Division responsibilities include:

- Review and evaluate user department telecommunications needs;
- Prepare technical specifications for telecommunications proposals and potential contracts for system acquisition;
- Coordinate voice mail implementation and administration;
- User department entry point for telecommunications moves, adds and changes (MAC) work orders;
- Perform cost analyses and alternative evaluations for access to the City's private network;
- Engineer trunks and circuits for access;
- Provide engineering of switches and transport facilities;
- Engineering for access to the City's private network for data services and other band width transport services;
- Budget and rate development, system planning, policy and procedure development and review and fiscal analyses;
- Administer and provide expertise on all matters relating to acquisition, installation and consolidation of Centrex service;
- Monitor the City's private network and services to detect and correct outages, anticipate potential problems and allocate band width to meet changing user requirements;
- Develop and implement telecommunications special projects for the City;
- Act as City liaison with regulatory agencies regarding telecommunications issues; and
- Planning, designing, maintaining and coordinating telecommunications for departments, boards and commissions of the City and County of San Francisco (San Francisco Administrative Code, Chapter 22B).

II. 800MHz PROJECT MANAGEMENT

The 800MHz project management group provides expertise and oversight for managing and consulting with Fluor Daniel and the development and implementation of the new 800MHz radio system. The project management team is responsible for implementing the $40 million project to coincide with the opening of the new 911 center. Specific responsibilities include overseeing the development

of the competitive bid documents, working with various City agencies to sell the 800MHz bonds, gaining various governmental approvals and the implementation of the 800MHz radio system. Additional responsibilities include working with all City agencies to successfully implement the new 911 center. Some of the project team's responsibilities are:

- Competitively bidding the 911 telecommunications answering system.
- Competitively bidding the dispatch consoles to be used with the new 800MHz radio system and the Computer Aided Dispatch (CAD) system.
- Advising and consulting with 911 Project Manager.
- Make decisions which have a direct impact on the CCSF operations.

III. RADIO DIVISION

The Radio Division provides expertise and services by managing, consulting, designing, estimating, specifying, licensing, procuring and installing City-owned radio electronic communications systems and equipment. The Radio Division is comprised of the Engineering and Service Sections.

Special radio electronic projects funded by work orders are also part of the Division's responsibility. Eighty-five percent of the Division's total operation is directly related to public safety agencies, i.e., Police, Sheriff, Fire, Public Health and Public Works.

Engineering Section

The Engineering Section functions are to consult, plan, design and manage radio electronic communication systems for various departments and maintain proper Federal Communications Commission radio station licensing. It is staffed by Radio Engineers (Program Managers), Senior Radio Technicians, and Radio Technicians.

Service Section

The Service Section function encompasses installation, inspection, maintenance, repair and modification of radio electronic communications systems for various departments. It is staffed by a Senior Radio Technician (Shop Supervisor) and Radio Technicians.

The Radio Division is mandated to obtain and manage Federal Communications Commission radio licenses (Title 47 Code Federal Regulations); provide Radio Communications Facilities (San Francisco. Administrative Code, Chapter 22); insure radio equipment complies with applicable laws and standards; and represent the City before the FCC. The Division makes recommendations for proposed radio systems and functions as a technical advisor to all departments. The Division is

responsible for installation, repair, maintenance and inspection of the backbone of the City's entire radio communications equipment. These consist of base stations, dispatch consoles and microwave links.

Additionally, the Radio Division responsibilities include:

- Install, repair, maintain and inspect the City's entire fleet of radio communications equipment;
- Install, repair, maintain and inspect other City ancillary electronic communications equipment;
- Advise and consult with State Communications Advisory Board;
- Make rules and regulations affecting operational procedure and insure conformity to applicable law by City departments;
- Investigate proposed radio communications expenditures; and
- Assist Purchaser in standardization of equipment and supplies.

IV. FINANCIAL ADMINISTRATION DIVISIONS

The Administration Division provides services to the Department in areas of management, administration, accounting, budgeting, purchasing, storekeeping, payroll, clerical, personnel, and custodial services.

General Services Division

This Division is responsible for storekeeping, department facilities and vehicles, and the operation of the City Hall operators who provide service to the Civic Center City locations.

Accounting, Billing, and Computer Services Divisions

The Accounting Division is responsible for the continued payment of all City-wide communications invoices, communications billing, amortization and vendor invoices. Other responsibilities include: payroll, managing the clearing account, operating a computerized billing system which includes back charging to other City departments and interfacing with the Controller's Office. This Division is responsible for the payment, auditing, analysis, report, record keeping, cost recovery of City-wide telecommunications expenses and is dedicated to analyzing costs and developing new automated systems which will increase service, accuracy and savings to the City.

V. PUBLIC SAFETY DIVISION

Operations Division

The Public Safety Division - Operations maintains the Central Fire Alarm Station and outside wire plant for the Public Safety Communications Network which includes the following: fire alarms, Mayor's Emergency Telephone System (METS), SFFD data lines, high pressure automatic valve circuits and radio lines. Twenty-four (24) hour dispatch of fire alarms and evening dispatch of Animal Control. Responsibilities also include maintenance, alteration and repair of City-owned street lighting systems and installation and maintenance of burglar alarm systems for other City agencies.